In-Situ Ground Water Cleanup of Heavy Metal Contaminants: MOP-UP™ Process

Developer: Biopraxis, Inc.
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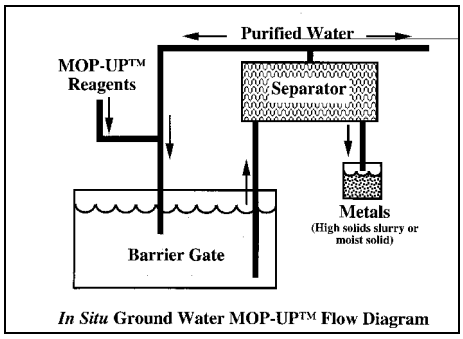
Crosscutting Area: ESP

Subsurface Contaminants FOCUS AREA

Problem:

It is extremely difficult to treat highly acidic media containing heavy metal and radionuclide pollutants, especially in the presence of high concentrations of iron, sulfate, organics, and/or chelating agents. Acid leaching processes can pollute surface and ground waters with complex, strongly acidic mixtures containing high levels of heavy metals, iron, sulfate, and various organics. Such pollution is produced from coal piles and fly ash pits, coal mines, and metal sulfide mines. Therefore, this pollution is prevalent at Department of Energy (DOE), military, utility, and industrial sites with coal-powered energy plants, as well as hundreds of thousands of abandoned mines scattered throughout the United States.

Pollution prevention problems often involve similarly complex, acidic mixtures including: many process effluents produced by metal-working industries, such as waste waters from printed circuit board and semiconductor manufacturing; metal surface cleaning and stripping, surface treatment (e.g., chromating, anodizing, and passivating), electroplating and electroless plating, draining and rinsing, and coating operations; and photofinishing and printing.



In Situ Ground Water MOP-UP™ Flow Diagram

Solution:

In situ remediation can significantly reduce cleanup costs. Worker exposure can be reduced by eliminating or minimizing waste excavation, transportation, and disposal. Additionally, cleanup of inaccessible sites such as deep subsurfaces and areas beneath structures is enabled. In situ containment can prevent the spread of pollution on a short-term basis while the source plume is being remediated, or be used as a long-term pollution control mechanism for sites presenting no immediate danger or requiring development of new remediation methods.

Biopraxis is developing a new heavy metal treatment technology, called MOP-UP™. The flexible MOP-UP™ technology can be configured in many different ways to suit the requirements of many different applications. For groundwater treatment, an approach that provides both in situ containment and in situ treatment, i.e., a reactive barrier that can be readily regenerated, is being developed. The proposed approach exploits a reactive barrier "funnel and gate" system. The "funnel" consists of impermeable barriers that force the groundwater to pass through the "gate", i.e., a filter wall. The MOP-UP™ reagents will be pumped into the filter wall, where they react with the contaminants in the ground water. Periodically, the MOP-UP™ reagents will be pumped to the surface and cycled through a separator. The purified water will be returned to the ground as a carrier for introducing a fresh batch of reagent into the filter wall, while the metal-containing fraction is recovered as a high-solids slurry or moist solid.

Benefits:

MOP-UP™ has a wide range of applications, including pollution prevention, hazardous waste minimization, and resource recovery and recycling, as well as cleanup of contaminated surface and ground water, soils, and sediments.

Benefits include:

▸Treatment of heavy metal and radionuclide pollutants in highly acidic media, as well as neutral and alkaline media

▸Treatment of media containing high levels of iron, sulfate, and other inorganics

▸Processing of media containing organics and chelating agents without any pretreatment steps

▸Reduction of many heavy metal and radionuclide contaminants to sub-parts per billion levels without the use of any flocculants or coagulants, or any filtering or polishing steps

▸Production of a very small volume of metal precipitate, either as a high-solids slurry or as a moist solid

▸Utilization of simple, rugged, low-maintenance, commercially-available hardware

▸Treatment of large water or slurry volumes with very low power consumption

Technology:

MOP-UP™ exploits reagents derived from or produced by microorganisms. Formulations containing these reagents are mixed with the polluted medium, where they take up heavy metal and radionuclide pollutants. The metal removal process is extremely rapid. For example, one reagent being screened for ground water treatment under the DOE program has been shown to remove all detectable traces of cadmium-109 from 10 ppm solutions within 15 minutes throughout the range ≥ pH 2.

MOP-UP™ reagents have been shown to take up extremely high amounts of metal, some accumulating as much as 10 times their own weight in metals within two hours. The metal-encrusted reagents are then separated from the treated medium by either of two proprietary separation technologies. This simple, two-step process yields two streams: a high-solids slurry or moist solid containing the metals, and the purified medium. The reagents can be produced in bulk easily and very economically. Both of the proprietary separation systems are commercially available. Because the recovered metal fraction does not contain any additives such as flocculants or coagulants, only a very small volume of sludge is produced. Therefore, transportation and disposal are far less expensive. Alternatively, there are no additives and the recovery and recycling of valuable and/or strategic metals and radionuclides can be very economical.

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